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ABSTRACT

This study was designed to provide schools, districts, and states with a means for identifying the knowledge and skills that are most important for students to learn in the subject areas of language arts, mathematics, and science. The standards and benchmarks in this document reflect the subject-area content consistently identified in documents from a handful of states that have been highly rated by national organizations for the quality of their standards. (Contains 26 references.) (MM)

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INTRODUCTION

Purpose

This study was designed to provide schools, districts, and states with a means for identifying the knowledge and skills that are most important for students to learn for the subject areas of language arts, mathematics, and science. The standards and benchmarks in this document reflect the subject-area content consistently identified in documents from a handful of states that have been highly rated by national organizations for the quality of their standards. It is hoped that this material will assist those who are attempting to reduce the amount of content identified as important to a manageable level.

In recent years, it has frequently been observed that all of the knowledge and skills identified as important by national organizations cannot be addressed in the classroom given the time available in the school day. Education researcher Chester Finn, after reviewing documents produced by many standards-setting groups, asserted that "the professional associations, without exception, lacked discipline. They all demonstrated gluttonous and imperialistic tendencies" (in Diegmueller, 1995, p. 6). A similar perspective can be found in the report of the Third International Mathematics and Science Study (TIMSS), a large-scale, cross-national comparative study of math and science curricula. In addressing the relatively poor performance of U.S. students, the report's authors note that our "preoccupation with breadth rather than depth, with quantity rather than quality, probably affects how well U.S. students perform in relation to their counterparts in other countries" (Schmidt et al., 1997). Researchers Marzano and Kendall (1999) show that at least by one measure, attempting to address all the content identified in standards documents would mean that "schooling would have to be extended from kindergarten to grade 21" (p. 104). It appears evident that practitioners and others could find this report to be of some use if they seek to ensure that as they reduce content to a manageable amount, they retain the most significant knowledge and skills.

Method for Selecting the Top State Documents

Five state standards documents were selected to represent the exemplary content in each subject area. In order to select these documents, we analyzed the critical reviews of state documents conducted by three national organizations: the American Federation of Teachers, the Fordham Foundation, and the Council for Basic Education. For the areas of language arts and mathematics, all three organizations have published such reports, which provide a rating or ranking based on selected criteria. For the area of science, the American Federation of Teachers and the Fordham Foundation have each published such a report.

Selection of State Documents by Subject Area

For each of the three subject-areas — language arts, mathematics, and science — we ranked the states according to how well they fared in the national reviews. With few exceptions, the top states were easily distinguished, ranking high in all reports. States that fared unevenly across the

reports were ranked after determining their relative merits within each report. In the rare instances in which a "tie" occurred, the selection was resolved based on review criteria developed by McREL researchers as a result of the extensive document reviews they have conducted for more than a half-dozen state departments of education and numerous school districts across the United States. A complete discussion of the ranking process appears in the introduction to each subject-area section.

Method of Identification and Synthesis

Once the five state documents were selected for a given subject area, the next step was to identify and classify the content found in these documents. In order to account for all content, we mapped most of the content we identified during the review process against the standards and benchmarks identified in *Content Knowledge: A Compendium of Standards and Benchmarks for K–12 Education* (Kendall & Marzano, 1999). The *Compendium* represents McREL's synthesis of 116 significant curriculum and standards documents across 14 subject areas. Knowledge and skills identified in the *Compendium* are presented in each subject area as overarching categories (or *standards)* under which the knowledge and skills appropriate for students at particular grade ranges (*benchmarks*) are organized. We selected the *Compendium* as a cataloguing tool because it represents a synthesis of major documents in each subject area and thus very likely identifies most, if not all, of the significant content in each subject area.

The next step of the process involved identifying and organizing all of the similar content in the selected state documents. Briefly, the method consisted of identifying each description of knowledge or skill in the state documents and matching that content to the *Compendium* benchmark that addressed the same, or closely related, knowledge or skill. If necessary, the *Compendium* benchmark was rewritten in order to more accurately reflect the content described in several state documents. Alternatively, when information in a state document did not explicitly match a benchmark but the pairing seemed a fair inference, the content was matched to the benchmark, but identified as having been implied in the document, rather than explicitly stated. Infrequently, when sufficient representation warranted it, new benchmarks were created that were not present in the *Compendium*. These new benchmarks were placed under the *Compendium* standard most suited to them. This approach is compatible with our use of the *Compendium* as a convenient organizing device, rather than a selection device or filter.

When the five state documents had been analyzed, the resulting product was a master document that organized all of the knowledge and skills identified in the five state documents, as well as information indicating where that content was found. This information is preserved in this report by a set of codes, called a *citation log*, which appears just above each benchmark — for example, BP (A2I;CA1;M22II;V,62), is the citation log for the K–2 benchmark "Uses complete sentences in written work," found under language arts standard #3. A key for the citation logs appears at the bottom of each page so that readers can locate the original material.

In addition to this basic document information, each citation log also includes a code that designates the cognitive character of each benchmark as either *declarative* knowledge or *procedural* knowledge. Simply put, declarative knowledge (identified in the log as *BD*) describes information — facts, events, episodes, generalizations, and the like — that students should know. Procedural knowledge (indicated by *BP*) describes the skills or processes — such as reading a map, editing, or adding — that students should be able to perform. (A more complete description of declarative and procedural knowledge can be found in the *Compendium,* pages 22–24). The citation log also sometimes includes an asterisk (*), to indicate that the content represents material not found in the *Compendium,* and/or a lowercase *i*, to indicate that the content was inferred from a state benchmark rather than that it was directly stated in the document.

Selection of Criteria for Reduction

The original intention was to provide a report that identified only that content that was common to all five documents. However, once the process was completed, it became clear that using such a method resulted in the identification of very few benchmarks. If we had selected only the content that was common to all five of the documents for any one subject area, the number of items, or benchmarks, that would have resulted would have been so small as to be of limited usefulness (as our preliminary analysis determined). This was the case whether the subject area was language arts, mathematics, or science. On the other hand, if we had selected content that was common to only *three* of the five state documents, the result would have been the identification of nearly as many, if not more, benchmarks than were found in the *Compendium*. We found, however, that if we selected benchmarks that were common to any *four* of the top five documents, the result was neither so small as to be not useful nor so large that it did not appear to serve the purpose of winnowing down the amount of content. Thus, for each content area, the standards and benchmarks identified in this study represent content that was found to be present in any *four of the five* standards documents selected for review.

Product and Caveat

The product of this study is a set of standards and benchmarks identified in three subject areas and at four grade bands: K–2, 3–5, 6–8, and 9–12. The benchmarks represent concepts and skills identified for student learning by at least four of the five states whose documents have been rated highly for, among other things, the clarity, specificity, and appropriateness of their standards. It should be noted that the technique described and used here is not designed to produce a clearly sequenced set of content. Further, this document should not be mistaken for a well-planned set of standards and benchmarks. Each document that we analyzed might well have possessed either an implicit or explicit design and scaffolding. Our technique was designed not to identify a scope and sequence, but, rather, to identify the concepts and skills that were most common to the five documents for each subject area. Thus, users of this document are encouraged to consider it as identifying knowledge and skills that across these documents, at least, could be considered essential.

LANGUAGE ARTS

Identification of National Reports

For the subject area of language arts, three evaluation reports were used to help select the state documents analyzed in this study. One report we used was the American Federation of Teachers' (AFT) *Making Standards Matter* (1998), which includes ratings of the state standards in terms of specificity and clarity. Another perspective on state standards was available from the Fordham Foundation in the report *State English Standards: An Appraisal of English Language-Arts/Reading Standards in 28 States* (Stotsky,1997). Finally, the Council for Basic Education evaluated language arts documents across the states in *Great Expectations: Defining and Assessing the Rigor in State Standards for Mathematics and English Language Arts* (Berman & Joftus, 1998).

Selection of Reference Documents

As we noted in the Introduction to this report, five state documents were selected for review for each subject area covered in this report. The selection of the top five state documents for language arts was determined by comparing information found in the three evaluation reports just described. Specifically, those states that received a "B" or above in the Fordham report were compared with those states identified in the AFT's *Making Standards Matter* report as having clear and specific standards and those states that were rated highly by the Council for Basic Education. As a result of this process, the following state documents were used for the analysis of language arts content:

English-Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve (1998), by the California Department of Education

Language Arts Standards (1999), by the Arizona Department of Education

Standards of Learning for Virginia Public Schools: English Standards of Learning (1995, June), by the Board of Education, Commonwealth of Virginia

The English Language Arts Curriculum Framework (1997, February), by the Massachusetts Department of Education

Wisconsin's Model Academic Standards for English Language Arts (1999), by the State of Wisconsin, Department of Public Instruction

It should be noted that although the Fordham Foundation rated the California language arts document highly (Olson, 1999), their review of this document was not available at the time of our selection process.

Findings

The standards and benchmarks that resulted from our synthesis of state standards follows this introduction. Unlike the findings in the areas of mathematics and science, no significant issues emerged as a result of the process of identification used for this study.

Summary of State Benchmarks for Language Arts

Table 1 provides a listing of the benchmarks developed by national groups which are included in the state standards document for at least four of the five top rated states in Language Arts. The state benchmarks are organized around the following eight Language Arts standards:

1. Demonstrates competence in the general skills and strategies of the writing process
2. Demonstrates competence in the stylistic and rhetorical techniques in writing
3. Uses grammatical and mechanical conventions in written compositions
4. Gathers and uses information for research purposes
5. Demonstrates competence in the general skills and strategies of the reading process
6. Demonstrates competence in the general skills and strategies for reading a variety of literary texts
7. Demonstrates competence in the general skills and strategies for reading a variety of informational texts
8. Demonstrates competence in speaking and listening as tools for learning

Table 1. Summary of State Language Arts Benchmarks

1. Demonstrates competence in the general skills and strategies of the writing process	
Grades K-2	
• Uses strategies to generate ideas for written work (e.g., brainstorming, webbing, mapping, drawing, discussing, selecting a focus)	BP(A1I;CA1;M19II;V,62;WB4)
• Uses strategies to draft and revise written work (e.g., focuses on one topic; groups related ideas and maintains consistent focus; uses elements of a specific genre; checks for clarity, content, organization, and relevant, descriptive details; adds information; accepts comments from classmates; improves sequence)	BP(A1I;CA2;M21II,V,62,63;WB4)
• Uses strategies to edit and publish written work (e.g., edits for grammar, punctuation, capitalization, spelling, sentence structure; shares final copy with others; uses own standards or judgments of quality; uses available technology to publish written work)	BP(A2I;CA1;M22II,25II;V,61,62,63;WB4)
• Uses strategies to organize written work (e.g., includes beginning, middle, and end; uses a logical sequence of events)	BP(A2I;CA2;M19II;V,63;WB4)
• Uses a variety of strategies (e.g., drawing pictures, using letters or phonetically spelled words, telling, narrative or expository writing) to describe experiences, people, objects, events, places, and story elements	BP(A1K;CAK,1,2;V61,62;WB4)
• Uses a variety of forms or genres for writing (e.g., stories, friendly letters, memos, invitations, explanations, personal experience narratives)	BP(A2I;CA2;M20,II;V,63;WB4)
Grades 3-5	
• Uses a variety of strategies to generate ideas for written work (e.g., develops a plan, groups related ideas, organizes information according to type and purpose of writing)	BP (A2II;CA,3;M19II;V,64,67;WB4)

Codes (right side of page)
State Codes
A1-4K, I-IV = AZ; Std #; I-IV: Kindergarten, Prim, Elem. Middle, H.S.
CAK-8,9-12 = CA; K-8; 9-12: H.S.
M1-28, I-IV = MA; Std #, I-IV; Prim., Elem., Middle, H.S.
V = VA, page #
WIA-F; 4,8,11 = WI; Std letter; grades 4, 8, 11

Other Codes
BD = Benchmark, Declarative
BP = Benchmark, Procedural
• = Benchmark not present in *Compendium*
i = Implied in document

• Uses strategies to draft and revise written work (e.g., produces multiple drafts; focuses on a central idea; includes descriptive details; uses elements of style, such as word choice, tone, voice, sentence variation; organizes ideas; revises for clarity, content, vocabulary, details, sequence, coherence, point of view; adds, deletes, consolidates, and rearranges text)	BP(A2II;CA3,4;M21II;V,64,66,67;WB4)
• Uses strategies to edit and publish written work (e.g., edits for grammar, punctuation, capitalization, and spelling; uses resources to edit and proofread, such as word lists, dictionaries, spell checker, style manuals; uses own standards or judgment of quality to evaluate work; presents final work according to purpose, by displaying, publishing, mailing, performing, reading aloud; uses available technology to publish written work)	BP(A2II;CA4,5;M22II;V,64;WB4)
• Uses strategies to write for a variety of audiences (e.g., adapts content, focus, point of view, style, and structure; uses appropriate genre; determines knowledge and interests of audience)	BP(A2I;CA3,4;M20II;WB4)
• Uses strategies (e.g., adapts focus, point of view, organization) to write for a variety of purposes (e.g., to inform, entertain, explain, describe)	BP(A2I;CA3,4;V,67;WB4)
• Uses strategies to write expository text (e.g., states, develops, and provides a concluding statement for a point of view about a narrow topic; conveys essential details and facts; provides accurate representations of events and sequences; uses different structures such as chronology, cause-and-effect, similarities and differences; frames a central question about an issue; uses several sources of information)	BP(A2II;CA4,5;M20II *i*;V64;WB4)
• Uses strategies to write narrative text (e.g., develops a clear story line in sequence; uses descriptive words and phrases; develops characters, setting, plot; uses dialogue; provides a context for action; provides insight into why an incident is memorable; relates ideas or an event or experience; establishes point of view and conflict)	BP(A2II;CA3,5;M20II *i*;V64,66;WB4)
• Writes in response to literature (e.g., uses examples from the text, other works, prior knowledge, or experiences; relates own ideas to supporting details; summarizes main ideas and significant details; develops interpretations based on careful reading)	BP(A2II;CA4,5;V,64;WB4)

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• Uses strategies to write personal and formal letters (e.g., organizes ideas; includes date, salutation, body, closing, and signature)	BP(A2II;CA3;M19I *i*;V,64;WB4)
Grades 6-8	
• Uses a variety of strategies to generate ideas for written work (e.g., note taking, outlining, summarizing)	BP (A2III;CA7;M19III;V,68;WB8)
• Uses strategies to draft and revise written work (e.g., establishes central idea, organization, elaboration, unity; uses vocabulary and information to convey central idea, tone, and voice; addresses purpose and audience; revises for clarity, word choice, organization, consistent point of view, transitions, diction, underlying logic, consistency of ideas)	BP (A2III;CA6,7,8;M21III;V,68,71;WB8
• Uses strategies to edit and publish written work (e.g., edits for sentence structure, mechanics, usage, spelling; uses established criteria to evaluate own and others' writing; uses available technology, such as a word processor, publishing program, database, or spreadsheets to publish written work)	BP (A2III;CA7,8;M22III;V,68,70;WB8)
• Uses content, style, and structure appropriate for particular audiences, purpose, and situations (e.g., formal or informal language, genre, format, organizational pattern)	BP(A2III;CA6;M20III;WB8)
• Uses strategies to write expository text (e.g., states a thesis or purpose in introductory statement or paragraph, uses smooth transitions, ends with concluding paragraph, or summary or clincher statement; uses own words to develop ideas; uses supporting details, facts, examples, descriptions, evidence; uses common expository structures and features, such as compare-and-contrast or problem/solution)	BP(A2III;CA6;M13III;V,70;WB8)
• Uses strategies to write narrative text, including fiction and autobiography (e.g., draws from personal experiences; develops a clear story line in sequence; uses figurative language or descriptive words and phrases; develops plot, major and minor characters, setting, point of view, dialogue, suspense, action; reveals a specific theme)	BP(A2III;CA6,7;V,68;WB8)

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• Uses strategies to write persuasive text (e.g., conveys a point of view or a clear position; uses a discernible tone; forms a coherent argument; anticipates and addresses reader concerns and counter-arguments; includes detailed evidence, examples, and reasons)	BP(A2III;CA6;V,70;WB8)
• Uses strategies to write in response to literature (e.g., states an interpretive, analytic, evaluative, or reflective position; supports inferences or conclusions with examples from the text, personal experience, other works, or nonprint media; relates own ideas to supporting details; provides support adequate to the type of literary selection; develops and justifies ideas; draws inferences about the effects of the work on the audience)	BP(A2III;CA6;M12III;WB8)
Grades 9-12	
• Uses strategies to generate ideas for written work (e.g., considers audience and purpose in planning; develops a focus; organizes ideas and details)	BP(A2IV;CA9-10 *i*;M19IV;V,73,75,76;WB12)
• Uses strategies to draft and revise written work (e.g., uses specific vocabulary and information, clear word choice and vivid description; uses a specific point of view, characterization, and style; improves clarity, content, depth of information and presentation technique, accuracy, logic of organization, sentence variety, personal style; uses feedback from peers and teacher; rethinks how well he or she has addressed genre, purpose, and audience; highlights individual voice)	P(A2IV;CA9-10,11-12;M21IV;V,73-76;WB12,D12
• Uses strategies to edit and publish written work (e.g., edits for grammar, punctuation, capitalization, and spelling; suggests how writing could be improved; uses available technology, such as publishing software and graphic programs, to design and publish documents; uses visual aids, such as graphs, tables, pictures)	BP(A2IV;CA9-10,11-12;M,22IV;V,73;WB12)
• Uses strategies to adapt writing for different audiences (e.g., uses suitable content, vocabulary, style, structure, tone, and voice; considers background, age, and knowledge of audience; uses appropriate level of formality)	BP(A2IV;CA11-12;M20IV;V,75;WB12,D12)

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• Uses strategies to adapt writing for different purposes (e.g., to explain, inform, analyze, entertain)	BP(A2IV;CA11-12;M20IV;V,73;WB12)
• Uses strategies to write expository text (e.g., uses evidence to support a thesis, conveys information and ideas from primary and secondary sources; distinguishes relative importance of data, facts, ideas; uses visual aids to organize and record information; anticipates and addresses reader's biases and expectations; uses technical terms and notations)	BP(A2IV *i*;CA9-10;M20IV;V,73;WB12)
• Uses strategies to write fictional, autobiographical, and biographical narratives (e.g., develops point of view; presents events in logical order; conveys unifying theme or tone; uses concrete language and believable dialogue; uses literary elements of plot, setting, character, theme, resolution of conflict; uses sensory details to describe sights, sounds, smells, specific action, movements, gestures, feelings; uses interior monologue to convey feelings; paces action to accommodate changes in time and mood)	BP(A2IV;CA9-10;M13IV;V,73;WB12)
• Uses strategies to write persuasive text (e.g., includes a thesis statement to convey a point of view; uses details, facts, reasons, examples to develop point of view; uses language in a persuasive manner; writes a coherent argument that takes a position, summarizes opposing position, refutes opposing position, and cites persuasive evidence; uses rhetorical devices to support assertions (appeals to logic through reasoning, appeals to emotion or ethical belief, personal anecdotes, case studies, or analogies); addresses reader concerns, counterclaims, biases, and expectations)	BP(A2IV;CA9-10;M20IV;V,75;WB12)
• Uses strategies to write in response to literature (e.g., examines literature from several critical perspectives; analyzes author's use of literary elements, such as character, setting, theme, imagery; shows awareness of author's stylistic devices and effects created; supports important ideas and viewpoints through references to text or other works)	BP(A2IV;CA9-10,11-12;V,73;WA12)
• Uses appropriate strategies (e.g., organizational pattern, standard format, formal language, tone) to write a variety of personal and business correspondence (e.g., business letters, resumes, manuals, letters of application, memos)	BP(A2IV;CA9-10,11-12;V,75;WB12)

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2. Demonstrates competence in the stylistic and rhetorical techniques in writing	
Grades K-2	
• Uses descriptive words and details in writing (e.g., describes characters, setting, events in stories)	BP (A2I;CA1;V,62;WB4I)
Grades 3-5	
• Uses descriptive language in writing (e.g., common figures of speech, sensory details)	BP(A2II;CA3;V,64,67;WB4I,WD4
• Uses paragraph form in writing (e.g., uses indentation; uses topic sentences and simple supporting facts and details; includes an introduction and a conclusion to summarize; writes multiple paragraphs)	BP(A2II;CA3,4;M5II;V,66)
Grades 6-8	
• Uses descriptive and specialized vocabulary (e.g., uses a thesaurus to choose specific, effective words; uses words with Latin and Greek roots; uses sensory images and comparisons; uses figurative language)	BP(A2III;CA6;M8III,15III;V,70)
• Uses a variety of sentence structures (e.g., simple, compound, complex, parallel, clauses, phrases, coordinate, subordinate) to expand and embed ideas	BP(A2III;CA6,7,8;M5III,22III;V,68,70,71;WB8)
Grades 9-12	
• Uses precise language to achieve different purposes (e.g., to vividly describe; to elaborate on ideas; to explain concepts in literature; to translate concepts into simpler or more easily understood terms; to express action; to achieve a specific tone)	BP(A2IV;CA9-10,11-12;M21IV *i*;V,74;WB12)
• Uses paragraph form in writing (e.g., arranges paragraphs into logical progression, uses a parallel structure)	BP(A2IV;CA9-10;M19IV;V,73)

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• Uses a variety of sentence structures (e.g., compound, complex, compound-complex, parallel, repetitive, analogous)	BP(A2IV;CA9-10,11-12;M5IV;V,73;WB12)
3. Uses grammatical and mechanical conventions in written compositions	
Grades K-2	
• Uses complete sentences in written work	BP(A2I;CA1;M22II;V,62)
• Uses conventions of grammar and usage in written work (e.g., subject-verb agreement; parts of speech, such as singular and plural nouns; appropriate verb tense; regular plurals; adjectives)	BP(A2I;CAK,1,2;M22II;V,63;WB4)
• Uses conventions of spelling in written work (e.g., spells high-frequency words and phonetically regular words; uses letter/sound relationships; spells basic short vowel, long vowel, *r*-controlled, and consonant-blend patterns)	BP(A2K,I;CA1,2;V,62;WB4)
• Uses conventions of capitalization in written work (e.g., capitalizes sentence beginnings, proper nouns, the pronoun *I*, months and days of the week, titles and initials of people)	BP(A2I;CA1,2;M22I;V,62,63;WB4)
• Uses conventions of punctuation in written work (e.g., ending punctuation; commas in heading, greeting, closing, and address of a letter; commas in dates and items in a series; quotation marks; contractions and singular possessive pronouns)	BP(A2I;CA,1,2;M22I;V,62;WB4)

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M1-28, I-IV = MA; Std #, I-IV; Prim., Elem., Middle, H.S.
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WIA-F; 4,8,11 = WI; Std letter; grades 4, 8, 11

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Grades 3-5	
• Uses conventions of grammar and usage in written work (e.g., uses nouns, pronouns, adjectives, adverbs, adverbial words and phrases, regular and irregular verbs; uses the pronoun *I* in compound subjects; uses conjunctions to separate sentences and connect independent clauses; uses participial and prepositional phrases; uses past, present, and future verb tenses; forms plurals; follows principles of agreement: subject-verb, gender, number, case; avoids double negatives)	BP(A2II;CA3,4,5;M5II;V,66;WB4)
• Uses conventions of spelling in written work (e.g., frequently used words; one-syllable words that have blends; contractions; compounds; patterns; common homophones; roots; inflections; suffixes; prefixes)	BP(A2II;CA3,4,5;M5II;WB4)
• Uses conventions of capitalization in written work (e.g., sentence beginnings, titles, abbreviations, proper nouns, countries, cities, months, days, geographic names, holidays, historical periods, special events, works of art, organizations, first word in quotations)	BP(A2II;CA3,4;M5II;WB4)
• Uses conventions of punctuation in written work (e.g., commas in series, dates, and addresses; possessives and quotation marks; commas in a greeting and closing in a letter; quotations in dialogue; apostrophes; commas for items in series; parentheses; underlining; italics for titles; colon to separate hour and minutes; quotation marks around direct quotations and titles of poems, songs, short stories; declarative, interrogative, imperative, and exclamatory sentences)	BP(A2II;CA3,4,5;M5II;V,66,67;WB4)
Grades 6-8	
• Uses conventions of grammar and usage in written work(e.g., uses principles of agreement: pronoun-noun, preposition-pronoun, subject-verb; uses proper pronoun case; uses parts of speech: adverbs; comparative adjectives; uses relative and indefinite pronouns; uses present perfect, past perfect, and future verb tenses; uses prepositions; uses infinitives and participles; uses modifiers; uses coordinate and subordinate conjunctions)	BP(A2III;CA6,7,8;M5III;V,68,71;WB8)

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• Uses conventions of spelling in written work (e.g., for frequently misspelled words, such as *their*, *they're*, and *there*; uses spelling of bases and affixes to spell derivatives)	BP(A2III;CA6,7;M5III;V,68;WB8)
• Uses conventions of capitalization in written work (e.g., for sentence beginnings, titles, abbreviations, proper nouns, direct quotations)	BP(A2III;CA6;M5III;V,68;WB8)
• Uses conventions of punctuation in written work (e.g., sentence endings, commas in a series, commas in compound sentences, abbreviations, quotation marks, colon in a business letter greeting, apostrophes, semicolons to connect independent clauses, hyphens, dashes, brackets)	BP(A2III;CA6,7;5III;V,68;WB8
Grades 9-12	
• Uses conventions of grammar and usage in written work (e.g., pronoun-noun and preposition-pronoun agreement; gerunds, infinitives, participles; phrases and clauses; consistent verb tenses; conditional tenses)	BP(A2IV;CA9-10,11-12;M5IV;V,73;WB12)
• Uses conventions of spelling in written work (e.g., spells frequently used words correctly and uses effective strategies for spelling unfamiliar words; uses a dictionary or thesaurus to aid spelling)	BP(A2IV;C9-10;M5III;V,73;WB12)
• Uses conventions of capitalization in written work	BP(A2IV;CA9-10;M5IV;V,73;WB12)
• Uses conventions of punctuation in written work (e.g., commas, ellipses, apostrophes, semicolons, colons, hyphens, dashes, italics)	BP(A2IV;CA9-10;M5IV;V,73;WB12)
4. Gathers and uses information for research purposes	
Grades K-2	
• Uses a variety of sources to gather information (e.g., table of contents, pictures, charts, dictionaries, indices, video tapes, television programs, magazines, informational books, guest speakers, Internet, own observations)	BP(A2I;M26II;V,63;WF4)
Grades 3-5	

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• Uses a variety of strategies to identify topics to investigate (e.g., constructs questions, narrows the focus of a topic, identifies prior knowledge, develops a plan for gathering information)	BP(CA5;M23II;V,66;WF4)
• Uses a variety of print and non-print sources to gather information (e.g., encyclopedias, dictionaries, thesauruses, card catalogs, informational trade books, interviews)	
• Uses electronic media to gather information (e.g., databases, Internet, CD-ROM, television shows, cassette recordings, videos, pull-down menus, word searches)	BP(CA5;M26II;V,67;WF4)
• Uses strategies to gather and record research information (e.g., uses notes with important concepts; notes direct quotes; paraphrases; summarizes; uses maps, charts, graphs, tables; cites information sources)	BP(A2II;CA3;V,67;WF4)
• Uses strategies to write research reports (e.g., evaluates and synthesizes information for use in writing; incorporates notes into a finished product; uses appropriate visual aids; includes simple facts, details, explanations, examples)	BP(A2II;CA5;V,66;WF4
• Uses strategies to cite reference sources (e.g., quotes or paraphrases information sources, lists resources used by title)	BP(A2I,II;CA4;V,66;WF4I)
Grades 6-8	
• Uses a variety of print, nonprint, and electronic sources to gather information for research topics (e.g., card catalogs, atlases; dictionaries; globes; encyclopedias; databases; almanacs; fact books; pamphlets; technical manuals; online databases; computer networks and modems; magazines; newspapers; indexes, including the *Reader's Guide to Periodicals*; interviews)	BP(A2III;CA6,7,8;M2III,26III;V,69,70,72;WF8)
• Uses a variety of methods to organize and synthesize research information (e.g., uses graphic organizers; takes notes that summarize or paraphrase information; records important ideas, concepts, quotations; uses charts, graphs, maps)	BP(A2III;CA8;M23III;V,70;WF8)

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• Uses strategies to produce an organized written or oral research report (e.g., incorporates notes into finished product; presents and reflects on findings; draws conclusions; adheres to conventions; supports main ideas with facts, details, examples from multiple sources; conveys a clear perspective; achieves balance between research information and original ideas)	BP(A2III;CA6,7,8;M24III;WF8)
• Uses appropriate format and methodology to cite reference sources (e.g., bibliography, footnotes)	BP(A2III;CA7;V,70;WF8)
Grades 9-12	
• Uses appropriate methodology and research strategies (e.g., develops a plan for research; uses appropriate research methods, such as questionnaires, experiments, field studies; collects information to narrow and develop a topic and support a thesis)	BP(CA9-10,11-12;M24IV;V,75;WF12)
• Uses a variety of print and electronic resource materials to gather information from primary and secondary sources (e.g., databases, microfiche, almanacs, news sources, field studies, speeches, journals, technical documents, card catalogs, interviews, experiments)	BP(A2IV;CA9-10;M26IV;V,73;WF12)
• Uses a variety of criteria to evaluate the accuracy and credibility of research information (e.g., knowledge of author, topic, or context; use of logic, propaganda, language, bias, position; date of publication; arguments used; comprehensiveness of evidence)	BP(A2IV;CA9-10;M26IV;V,74;WA12,F12
• Uses strategies to produce an organized written or oral research report (e.g., includes a thesis about a subject; uses facts, examples, details, quotes from credible, accurate sources; synthesizes information from a variety of sources; uses technological aids; paraphrases ideas and connects them to other sources and related topics; identifies complexities and discrepancies in information; identifies different perspectives; offers support for the conclusions; integrates quotations and citations into flow of paper)	BP(A2IV,CA9-10,11-12;V,73,74,75,76;WF12)

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• Uses standard format and methodology for documenting reference sources (e.g., credits quoted and paraphrased ideas; understands the meaning and consequences of plagiarism; distinguishes own ideas from others'; uses a style sheet method for citing sources, such as MLA, APA, or *Chicago Manual of Style*; includes a bibliography of reference materials)	BP(A2IV;CA9-10;M,V,73;WF12)
5. Demonstrates competence in the general skills and strategies of the reading process	
Grades K-2	
• Understands how print is organized and read (e.g., holds print materials in the correct position; knows front cover, back cover, title page, name of author and illustrator, and table of contents; follows words top-to-bottom and left-to-right; knows uppercase and lowercase letters of the alphabet; knows letters, words, and sentences; knows the connection between print and illustrations)	BD(A1K;CAK,1;V,60,62;WA4)
• Uses a variety of meaning clues (e.g., uses pictures, title, cover, key words, headings, illustrations; uses general knowledge of story, structure, sequence, and topic; uses prior knowledge) to understand text and make predictions about content (e.g., actions, events, behaviors)	BP(A1K,I;CAK,1;M9II;V,61,62,63;WA4)
• Uses basic elements of phonetic analysis (e.g., understands sound-symbol relationships; uses beginning and ending consonants to decode single-syllable words; uses vowel sounds and patterns; blends beginning, middle, and ending sounds; uses word patterns; blends vowel and consonant sounds) to decode unknown words	BP(A1K,1I;CA1;M8II;V,62,63;WA4)
• Uses basic elements of structural analysis (e.g., prefixes, suffixes, root words, contractions, possessives, abbreviations, sentence structure, compound words) to decode unknown words	BP(A1I;CA2;M4II;V,62,63;WA4)
• Reads familiar stories, poems, and passages with fluency and appropriate expression (e.g., pitch, tempo, tone)	BP(CA1;M18II;V,62;WA4)

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Grades 3-5	
• Establishes a purpose for reading (e.g., to gain information, learn about a viewpoint, appreciate literature)	BP(CA4;M9III;V64;WA4)
• Uses a variety of methods to make, confirm, and revise predictions (e.g., previews illustrations, headings, and format; uses prior knowledge; uses illustrations, titles, topic sentences, important words, foreshadowing clues)	BP(A1I;CA3,4;M9II;V,64;WA4)
• Uses phonetic and structural analysis to decode and pronounce unfamiliar words (e.g., letter/sound relationships, less common vowel patterns, homophones, word origins, synonyms, antonyms, homonyms, multiple meanings, homographs, idioms, common root words, prefixes, suffixes, syllabication, complex word families)	BP(A1II;CA3,4;M7II,8II;V,64,65,66;WD4)
• Uses context clues to decode and understand new words (e.g., figurative or metaphorical use of words)	BP(A1II;CA3,4;M8II;V,64;WA4)
• Uses word reference materials to understand the meaning of unknown words (e.g., definitions and synonyms in dictionaries, glossaries, thesauruses)	BP(CA3,4;M4II;V65;WD4)
• Understands author's purpose and elements that help to achieve that purpose (e.g., language, form, setting, specific information and details, persuasive techniques)	BD(A1II;CA5;V,65;WD4)
Grades 6-8	
• Uses word origins and derivations to understand word meaning (e.g., Latin and Greek roots, meanings of foreign words frequently used in the English language, historical influences on English word meanings)	BP(CA,8;M8III;V,68;WA8)
• Uses a variety of strategies to define and extend understanding of word meaning (e.g., uses sentence and word structures, context clues, analogies, idioms, similes, metaphors, synonyms, shades of meaning, antonyms, homographs, dictionaries for rhyming, classification books, etymological dictionaries)	BP(A1III;CA6,7,8;M4III,7III,8III;V,68,69;WA8)

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• Understands devices used to support author's purpose (e.g., relationships among style, form, and intended impact on reader; use of details; portrayal of themes and main ideas; use of a specific genre)	BD (A1III;M10III;V,69;WA8)
Grades 9-12	
• Uses a variety of strategies to understand origins and meaning of new words (e.g., context; roots, cognates, suffixes, prefixes; literal, figurative, technical, and idiomatic meanings; patterns of word endings; word relationships; knowledge of Greek, Latin, and Norse mythology; works alluded to in British and American literature; word derivations)	BP(C9-10,11-12;M7IV,8IV;V,72;WA12)
• Understands the use of writing devices to influence the reader and accomplish an author's purpose (e.g., imagery, personification, figures of speech, and sounds used in poetry to evoke emotions; literary and technical language; formal and informal language; point of view; characterization; irony; structural features and organization; narrator)	BD (A1IV;CA9-10,11-12;M12IV,13IV;WA12,D12)
• Understands the philosophical assumptions, perspectives, and basic beliefs underlying an author's work (e.g., language that conveys point of view, attitudes, and values; clarity and consistency of political assumptions; whether philosophical arguments in a text contribute to the credibility of characters or the quality of a work)	BD(A1IV;CA11-12;M17IV;WA12,D12)
6. Demonstrates competence in the general skills and strategies for reading a variety of literary texts	
Grades K -2	
• Uses reading strategies to understand a variety of fiction and nonfiction texts (e.g., story books, poems, fairy tales, narratives, fables)	BP(A1II;CA1;M10II;V,62;WA4)
• Knows sequence, setting, characters, main events, and plot in stories	BD (A1K,I;CAK,1;M12II;V,61,62)
• Understands the main ideas or theme in a text	BD(A1I;CA1;M11II;V,62,63)

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• Uses prior knowledge and personal experience to understand text (e.g., events, characters, conflicts, themes)	BP(A1K,I;M11I;V,62;WA4)
Grades 3-5	
• Uses reading strategies to understand a variety of fiction and nonfiction texts (e.g., biographies, historical fiction, poetry, fiction, fairy tales, fables, narratives from different cultures, drama, nonfiction, myths, folk tales, legends)	BP(A1II;CA3;M10II;V,65;WA4)
• Knows the defining characteristics of a variety of literary texts (e.g., poetry, biographies, historical fiction, poetry, fiction, fairy tales, fables, narratives from different cultures, drama, nonfiction, myths, folk tales, legends)	BD(A1II;CA4,5;M10II;V,64,65;WA4)
• Understands basic elements of plot (e.g., main problem, conflict, resolution, cause-and-effect)	BD (A1II;CA3,4,5;M12II;V,66;WA4)
• Understands similarities and differences among works from various genres and cultures (e.g., lives of two people in biographies, character types and use of natural phenomena in tales from different cultures; setting, events, themes, point of view)	BD(A1II;CA4;M15II;V,64;WA4)
• Understands elements of character development in literary works (e.g., differences between main and minor characters; how dialogue and action establish a character's background and traits; the importance of a character's actions, motives, and appearances to plot or theme)	BD (A1II;CA3,4,5;M6II;V,66;WA4)
• Understands the different ways in which words and style are used (e.g., beat, rhythm, personification, alliteration, onomatopoeia, simile, metaphor, imagery) and their effects on a reader	BD(CA3,5;M14II,15II,17II;V,65,66;WD4I)

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Grades 6-8	
• Uses reading strategies to understand a variety of fiction texts (e.g., realistic, fantasy, historical, biographical, poetry)	BP (A1III;CA6;M10III;V,68,69;WA8)
• Understands the defining characteristics of literary forms and genres (e.g., short stories, essays, speeches, lyric and narrative poems, plays, novels, fiction, nonfiction, epics, fables, myths, drama)	BD (A1III;CA6,7,8;M9III,10III;V,68,70;WA8)
• Understands plot development in literary works (e.g., relationships between events and past or present actions; foreshadowing of future actions; use of subplots, parallel episodes, and climax; development of conflict and resolution; cause-and-effect relationships; degree to which plot is contrived or realistic)	BD(A1III;CA6,7,8;M12III;V,68,70;WA8)
• Understands character development in literary works (e.g., how qualities of the central character support the plot and determine resolution of the conflict; how form, such as narrative poem or lengthy fiction, affects character development; how characters are developed through their words, speech patterns, thoughts, actions, narrator's description, and interaction with other characters; how motivations of major and minor characters are revealed)	BD (A1III;CA6,7;M12III;V,68,70;WA8)
• Understands relationships among story elements (e.g., the influence of setting on problem and resolution; the relevance of setting [place, time, customs] to mood, tone, meaning of text; the features of theme conveyed through characters, actions, images; the contributions of characters, plot, setting to overall impact)	BD(A1III;CA6,8;V,69,70;WA8)
• Understands inferred and recurring themes in literary works (e.g., themes of bravery, loyalty, friendship, effects of loneliness, good vs. evil; historical, cultural, and social themes; themes across texts)	BD(A1III;CA7,8;M11III;V,69,70;WA8)

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• Understands the use of language and word choice in literary works to convey mood, images, and meaning (e.g., jargon; dialect; dialogue; multiple meanings; symbolism; irony; rhyme; voice; tone; sound, such as alliteration, assonance, consonance, onomatopoeia; figurative language, such as similes, metaphors, personification, hyperbole, allusion; sentence structure, line length, punctuation)	BD(CA6,8;M14III,15III;V,68,69,71;WA8,D8)
• Understands the effects of an author's style on a literary text (e.g., effects of word choice, speaker, and imagery on reader response; how genre characteristics accomplish a specific purpose)	BD(CA8; M10III;V,68;WA8)
• Understands the effects of point of view (e.g., first and third person, limited and omniscient, subjective and objective) in a literary text	BD(A1III;CA6,7;V,68,69;WA8)
• Understands the historical, social, and cultural influences on literary works (e.g., how a text reflects the heritage, beliefs, attitudes, and traditions of the author; how a text reflects the period, ideas, customs, and outlooks of a particular group of people in history)	BD (A1III;CA8;M17III;V,69;WA8)*
Grades 9-12	
• Reads a variety of literary works (e.g., literature from different eras and cultures, American literature, British literature, poetry)	BP(A1IV;CA9-10,11-12;V,72,73,74,76)
• Knows the defining characteristics (e.g., structures, images, messages) of literary forms and genres (e.g., dramas, one-act plays, full-length plays, literature from different cultures and historical periods, satires, parodies, allegory, pastorals, poetry, prose, novels, short stories)	BD(CA11-12;M11IV,14IV;V,72,73;WA12)
• Knows archetypes (e.g., banishment from an ideal world, universal destruction, supernatural helpers, magical objects, journeys and tests) present in a variety of texts (e.g., American literature, literature of other cultures, myths, literature based on oral tradition, political speeches, film, religious writing, propaganda)	BD(CA11-12;M16IV,17IV;V,73,74)

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• Understands themes across a variety of literary works and genres (e.g., universal themes in literature of all cultures, such as initiation, love and duty, heroism, death and rebirth; major themes in American literature)	BD(A1IV;CA9-10,11-12;M10IV,11IV;V,73,74;WA12)
• Understands the effects of an author's style and the use of complex literary devices and techniques on the overall quality of a work (e.g., image, sound, point of view, diction, dialogue, figurative language, syntax, allusions, symbols, irony, voice, tone, foreshadowing, understatement, overstatement, paradox, flashback, time and sequence, narrator, mood)	BD(A1IV;CA9-10,11-12;M8IV, 10IV, 12IV,14IV;V,72;WA12)
• Understands relationships between literature and historical period, culture, and society (e.g., influence of historical context on form, style, and point of view; influence of literature on political events; social influences of historical period on author's description of characters, plots, and setting)	BD(CA9-10,11-12;M9IV;V,72;WA12)
• Uses language and perspectives of literary criticism to evaluate literary works (e.g., based on ambiguities, subtleties, contradictions, ironies, and incongruities in a text; based on aesthetic qualities of style, such as diction, tone, theme, mood)	BP(CA9-10;M17IV;V,73;WA12)*
7. Demonstrates competence in the general skills and strategies for reading a variety of informational texts	
Grades K -2	
• Uses reading strategies to understand a variety of informational texts (e.g., written directions, forms, newspaper ads, warning labels, safety pamphlets, charts, graphs, signs)	BP(A1I;CA1,2;V,62;WA4)
• Understands the main idea and relevant facts in informational texts	BD(A1I;CA1;M9II;WA4)
• Summarizes and paraphrases information found in texts (e.g.., facts, details)	BP(A1I;CA2;V,63;WA4)
• Uses prior knowledge and experience to understand information in texts	BP(A1K,I;CA1;V,62;WA4)

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V = VA, page #
WIA-F; 4,8,11 = WI; Std letter; grades 4, 8, 11

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Grades 3-5	
• Uses reading strategies to understand a variety of informational texts (e.g., nonfiction, multi-step instructions)	BP(A1I;CA3;V,65;WA4)
• Uses text structures and organizers (e.g., type, headings, graphic features, paragraphs, format, topic sentences, table of contents, glossary, index) to understand information	BP(CA4;M13II;V,65;WA4)
• Summarizes and paraphrases information in texts (e.g., important ideas and details, supporting evidence)	BP(A1II;CA3,4;V,65;WA4)
• Uses structural patterns or organization to understand informational texts (e.g., chronological, logical, sequential order; compare-and-contrast; cause-and-effect; proposition and support)	BP(A1II;CA4;M13II;V,64;WA4)*
Grades 6-8	
• Uses reading strategies to understand a variety of informational texts (e.g., instructions, charts, tables, schedules, time lines, manuals, expository texts, persuasive texts)	BP(A1III;CA6,7;V,68,69;WA8)
• Summarizes and paraphrases information (e.g., in chronological, sequential, or logical order; conveys main ideas, critical details, and underlying meaning; uses own words or quoted material; preserves author's perspective and voice)	BP(A1III;CA7,8;V,68;WA8)
• Understands techniques that convey author's point of view (e.g., word choice, language structure, arguments)	BD(A1III;CA,7;V69;WA8I)
• Understands different devices used to support claims in informational texts (e.g., fact versus opinion, persuasive techniques, propaganda, inferences, generalizations)	BD(A1III;CA,6;V,69;WA8)
• Understands and uses a variety of organizational patterns in expository texts (e.g., chronology, cause-and-effect, compare-and-contrast, proposition and support)	BP(CA6,7;M13III;V,69;WA8)

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• Evaluates information in expository texts (e.g., relevance and accuracy of details, clarity and completeness, usefulness, coherence, logic, internal consistency, structural patterns, appropriateness of evidence)	BP(A1III;CA7,8;V,71;WA8)*
Grades 9-12	
• Uses reading strategies to understand a variety of informational texts (e.g., instructions for computer software, job descriptions, college applications, information about lab experiments, historical papers, government documents)	BP(A1IVI;CA9-10;V,72,73,75,76;WA12)
• Uses a variety of criteria to evaluate information (e.g., clarity, accuracy, author's bias, use of persuasive strategies, consistency, clarity of purpose, effectiveness of organizational pattern, logic, reasoning, expertise of author, propaganda techniques, authenticity, appeal to friendly or hostile audience, acknowledgment of reader concerns and counterclaims)	BP(A1IV;CA11-12;V,72,76;WA12)
• Draws conclusions and makes inferences about information in texts based on a variety of text features (e.g., evidence presented, expository structures, format, use of language, hierarchical structures, arguments used)	BP(A1IV;CA11-12;V,76;WA12,D12)
8. Demonstrates competence in speaking and listening as tools for learning	
Grades K-2	
• Listens and speaks in informal conversations and group discussions (e.g., initiates conversation; stays on topic; takes turns speaking; shares stories, experiences, information, ideas, and questions orally; participates as a contributor and leader; reports on a specific topic; asks questions for clarification and understanding; uses strategies to keep discussion going)	BP (A3K,CAK,2;M2II;V,60,63;WC4)
• Uses voice level, phrasing, pace, and intonation appropriate to situation (e.g., small-group settings, informal discussions, reports to class)	BP(CA2;M3II;V60,61;WC4)
• Gives and follows one- and two-step directions	BP(A3I;CA1;V,60,61;WC4)

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• Listens and responds to a variety of literary forms, such as stories, poems, rhymes, and songs (e.g., retells in sequence; relates information to own life; describes character, setting, plot)	BP(A3K;CA1,2;V,60,61;WC4)
• Uses listening and speaking vocabularies (e.g., number words, words to describe people, places, things, events, shape, color, size, location, actions; synonyms, antonyms; affixes, roots, homonyms, word analogies, common figures of speech)	BP(A3I;CA1;M4II;V60,61,63;WC4,D4)*
Grades 3-5	
• Asks and responds to questions (e.g., seeks ideas and opinions of others, asks for clarification and explanation of unfamiliar words and ideas, uses evidence to support opinions, answers questions directly, responds to others' ideas, elaborates on issues)	BP(A3II;CA,3,5;V,64,75;WC4)
• Uses clear and specific vocabulary (e.g., to communicate ideas, to establish tone, to present information)	BP(A3I;CA3;M3II;V,64)
• Uses speaking strategies (e.g., uses subject-related information and vocabulary, relates ideas and observations, incorporates several sources of information, incorporates visual aids or props, uses examples to support conclusions) appropriate to different types of presentations (e.g., brief oral reports; narrative, informational, descriptive presentations; reading aloud; autobiographical/fictional stories; dramatic readings and interpretations; recitations of poems; oral responses to literature)	BP(A3I,II;CA3,4,5;V,64,65,66;WC4)
• Uses a variety of nonverbal communication skills (e.g, eye contact, gestures, facial expressions, posture)	BP (CA5;M3II;V,66;WC4)
• Uses a variety of verbal communication skills (e.g., projection, tone, volume, rate, articulation, pace, phrasing)	BP(CA3,5; M3II;V,64;WC4)
• Organizes information and ideas for oral presentations (e.g., around major points, in sequence, or chronologically; with beginning, middle, end; with introduction and conclusion; in traditional structures, such as cause-and-effect, similarity and difference, posing and answering a question; in outlines and summaries)	BP(A3II;CA3,4,5;V,64,65,66;WC4)

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• Understands techniques used in various media (e.g., basic propaganda techniques; persuasive techniques, such as promises, dares, flattery; the use of fact, opinion, and misleading information; the use of images and symbols central to particular messages; techniques used in television; visual techniques used to influence opinions, decision making, and cultural perceptions)	BD(A4II;CA3,5M27II;WE4)
Grades 6-8	
• Asks questions for a variety of purposes (e.g., to elicit information and evidence, to seek elaboration and clarification of ideas)	BP(A3III;CA7;V,69;WC8)
• Listens in order to understand content, style, and purpose in spoken text (e.g., facts and opinions, points of view, key ideas, structure, relationship of parts to whole, sequence, speaker's argument, tone, mood, emotion, speaker's attitude and purpose, verbal and nonverbal messages, supported and unsupported statements)	BP(A3III;CA6,7,8;M1III;V,68,69;WC8)
• Uses a variety of strategies (e.g., uses specific organizational structure and point of view; uses notes and brief outlines, uses evidence and arguments to support opinions, uses visual media) to make oral presentations for different audiences and purposes	BP(A3III;CA6,7,8;M3III;V,68,69;WC8,D8)
• Uses verbal and nonverbal communication techniques (e.g., formal and informal word choice, pitch, feeling, tone, voice, eye contact, posture, gestures, rate, volume) to convey a message or sustain audience interest	BP(A3III;CA6,7,8;M3III;V,69)
• Understands techniques used in visual media and their impact on viewers (e.g., effects of text, image, camera angles, and sound in electronic journalism; use of symbols and images; use of persuasive messages and propaganda techniques; use of language and subject matter to influence cultural perceptions; use of graphics in print journalism)	BD(A4III;CA6,7;M27III;V,69;WE8)

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Grades 9-12	
• Evaluates own and others' effectiveness in group discussions and in formal presentations (e.g., own role in preparation and delivery; effectiveness of group process; accuracy, relevance, organization of ideas and evidence, clarity, delivery; effectiveness of illustrations, statistics, comparisons and analogies; relationships among purpose, audience, and content; logic and manipulative techniques; use of words, expressions, style, diction, tone, syntax, rhetorical structure, and conventions of language; speaker's bias; coherence of main points, types of arguments used; use of logical fallacies)	BP(A3IV;CA9-10,11-12;M2IV,3IV;V72,73,74,76;WC12,D12
• Uses strategies to make formal oral presentations (e.g., develops introductions and conclusions; includes definitions for clarity; uses relevant details to support main ideas; uses anecdotes, quotations, examples, statistics, analogies, and comparisons; uses logical organizational patterns; uses concise notes; cites information sources)	BP(A3IV;CA9-10;M3IV;V,72,76;WC12)
• Uses strategies to make persuasive presentations (e.g., presents a coherent argument that summarizes and refutes opposing positions; cites persuasive evidence; supports and defends ideas in a public forum; uses elements of classical speech forms, including introduction, first and second transitions, body, conclusion; uses rhetorical devices to support reasoning; addresses counter-arguments and concerns; uses logical, ethical, and emotional appeals that enhance a specific tone and purpose)	BP(A3IV;CA9-10,11-12;V,74;WC12)
• Uses strategies to present oral interpretations of literature (e.g., cites text in support of assertions; presents characters in improvisational, informal, and formal productions; conveys significant ideas, ambiguities, and nuances of the work; analyzes imagery, language, and universal themes; recites poems, selections from speeches, dramatic soliloquies)	BP(A4IV;CA9-10,11-12;M18IV;V,72;WC12)
• Uses appropriate strategies (e.g., language, expression, delivery, visual and sound effects) to present to different audiences (e.g., different backgrounds, ages, knowledge) and for different purposes (e.g., to present literary forms, to entertain, to defend a position, to explain information)	BP(A3IV;CA9-10,11-12;V,72,76;WC12,D12)

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• Uses a variety of verbal and nonverbal techniques for presentations (e.g., structures narrative or argument, interacts with audience, uses language and gestures for specific effects, makes eye context, speaks with varied inflection, enunciates with appropriate rate and volume) and demonstrates poise and control while presenting	BP(CA9-10,11-12;M3IV;V,72,76;WC12)
• Uses visual aids or technology to support presentations (e.g., charts, photographs, transparencies, slides, electronic media, text, images, sound)	BP(A4IV;CA9-10,11-12;V,76;WC12)
• Understands the techniques and impact of visual media (e.g., aesthetic effects of media; strategies used to inform, persuade, entertain, transmit culture; advertisements; perpetuation of stereotypes; special effects; impact of media on politics; techniques used for particular audiences; ways in which different media cover the same events; impact of media on daily life; persuasive techniques; use of music, camera angles, fade-outs, lighting to impact audiences)	BD(A4IV;CA11-12;M27IV;WE12)
• Uses strategies to contribute to group discussions (e.g., considers others' ideas and opinions before responding, summarizes information learned in discussions; formulates judgments about ideas under discussion; supports judgments with evidence; determines the purpose of discussions; acts as a leader, participant, and moderator; conveys criticism in a constructive way)	BP(CA9-10;M2IV;V,73;WC12)*

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MATHEMATICS

Identification of National Reports

For the subject area of mathematics, three evaluation reports were used to help select the state documents analyzed in this study. One report we used was the American Federation of Teachers' (AFT) *Making Standards Matter* (1998), which includes ratings of the state standards in terms of specificity and clarity. Another perspective on state standards was available from the Fordham Foundation in the report *State Mathematics Standards: An Appraisal of Math Standards in 46 States, the District of Columbia, and Japan* (Raimi & Braden, 1998). Finally, the Council for Basic Education evaluated mathematics documents across the states in *Great Expectations: Defining and Assessing the Rigor in State Standards for Mathematics and English Language Arts* (Berman, et al., 1998).

Selection of Reference Documents

As we noted in the Introduction to this report, five state documents were selected for review for each subject area covered in this report. The selection of the top five state documents for mathematics was determined by comparing ratings and evaluation information in the three reports just described. Specifically, those states that received a "B" or above in the Fordham report were compared with those states identified in the AFT's *Making Standards Matter* report as having clear and specific standards and those states that were rated highly by the Council for Basic Education. As a result of this process, the following state documents were used for the analysis of mathematics content:

The California Mathematics Academic Content Standards (Prepublication Ed.) (1998, February 2), by the California State Board of Education

Core Curriculum Standards: Mathematics (1994), by the Utah State Office of Education

Mathematics Standards of Learning for Virginia Public Schools (1995, June), by the Board of Education, Commonwealth of Virginia

Model Competency-Based Mathematics Program (1990, November), by the Ohio Department of Education, Division of Elementary and Secondary Education

West Virginia Programs of Study: Instructional Goals and Objectives (1995, June), by the West Virginia Department of Education

Findings

The standards and benchmarks that resulted from our synthesis of state standards follows this introduction. For the area of mathematics, at least one observation may be of interest.

It became clear that at least a few topics recommended in *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics, 1989) did not survive the process of identification for this study; that is, some concepts were not identified in at least four of the five state documents under review. In the area of statistics and probability, in particular, no benchmarks related to the concepts of *sampling* or *outliers* will be found. Similarly, although the idea of probability (i.e., the likelihood of something happening) *does* appear at the 3–5 and 6–8 grade bands, it *does not* appear at the K–2 or 9–12 grade band. In part these apparent anomalies are the result of the fact that two of the states identified for this study did not address statistics and probability in significant depth, and the material in a third state document did not treat the topic at a significant level of detail.

Thus, as indicated in the Introduction to this report (see Product and Caveat section), some caution is in order for those who intend to use this material. On the other hand, the presence or absence of material in this study on mathematics does reflect the content that commonly appears in highly rated standards documents.

Summary of State Benchmarks for Mathematics

Table 2 provides a listing of the benchmarks developed by national groups which are included in the state standards document for at least four of the five top rated states in Mathematics. The state benchmarks are organized around the following nine Mathematics standards.

1. Uses a variety of strategies in the problem-solving process
2. Understands and applies basic and advanced properties of the concepts of numbers
3. Uses basic and advanced procedures while performing the processes of computation
4. Understands and applies basic and advanced properties of the concepts of measurement
5. Understands and applies basic and advanced properties of the concepts of geometry
6. Understands and applies basic and advanced concepts of statistics and data analysis
7. Understands and applies basic and advanced concepts of probability
8. Understands and applies basic and advanced properties of functions and algebra

Table 2. Summary of State Mathematics Benchmarks

1. Uses a variety of strategies in the problem-solving process	
Grades K-2	
• Justifies the process he or she used to solve a numerical problem	BP(CAK;O,40;UK,02-4;W,53)
• Makes organized lists, tables, or charts to solve a problem	BP(CA2;),27;V,7;W,57)
• Uses whole number models (e.g., pattern blocks, tiles, or other manipulative materials) to solve problems	BP(CAK;UK,02-1;V,4;W49)
• Uses "guess and check" to solve problems	BP(CAK;;UK,01-2;V,4;W,49)
Grades 3-5	
• Uses a variety of strategies to solve problems (e.g., generalizes strategies from known solution process, states or restates problems in own words, discusses problem with peers)	BP (CA3;O28;U3,01-3;W61)
• Justifies the methods and reasoning behind a solution	BP (CA3;O,28;U3,03-2;W,61)
Grades 6-8	
• Uses a similar problem type to solve a problem Understands how to break a complex problem into simpler parts or use	BP (CA6;O,32;V,15;W,96)
• Uses a variety of strategies to understand problem-solving situations and processes (e.g., considers different strategies and approaches to a problem, restates problem from various perspectives)	BP (CA6;O,31;U6,01-1;W,96)

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• Formulates a problem, determines information required to solve the problem, chooses methods for obtaining this information, and sets limits for acceptable solutions	BP (CA6;O,96;U6,01-2;W,96)
• Generalizes from a pattern of observations made in particular cases, makes conjectures, and provides supporting arguments for these conjectures (i.e., uses inductive reasoning)	BP (CA6;O,31;U6,03-1;W,97)
• Constructs informal logical arguments to justify reasoning processes and methods of solutions to problems (i.e., uses informal deductive methods)	BP (CA7;O,31;U6,03-1;W97
• Understands the role of written symbols in representing mathematical ideas and the precise use of the special symbols of mathematics	BD (CA6;O,31;U7,02-2;W,97)
Grades 9-12	
• Uses a variety of strategies (e.g., identifies a pattern, uses equivalent representations) to understand new mathematical content and to develop more efficient solution methods or problem extensions	BP (O,87;UEA,01-1;V,148;W,147)
• Understands the concept of a mathematical proof	•BD (CA9-12;O,72;UIA,03-6;W,147)
• Constructs logical verifications or counter examples to test conjectures and to justify algorithms and solutions to problems (i.e., uses deductive reasoning)	BP (CA9-12;O,61;UEA,03-2;V,20;W,147)
2. Understands and applies basic and advanced properties of the concepts of numbers	
Grades K-2	
• Understands that numbers are symbols used to represent quantities or attributes of real-world objects	2.1.1.BD (CA2;O,27;UK,02-3;W,49)
• Counts whole numbers (i.e., both cardinal and ordinal numbers	BP (CAK;O,39;V,4;W,50)
• Understands symbolic, concrete, and pictorial representations of numbers (e.g., written numerals, objects in sets)	BD (CAK;O,27;U1,06-2;V,4;W,58)
• Understands basic whole number relationships (e.g., 4 is less than 10, 30 is 3 tens)	BD (CAK;O,39;U1,06;V,4;W,6)

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• Understands the concept of a unit and its subdivision into equal parts (e.g., one object, such as a candy bar, and its division into equal parts to be shared among four people)	BD (CA2;O,4;UK,12-1;V,5;W,56)
• Understands the relationships among fractions, decimals, mixed numbers, and whole numbers	BD (CA4;U3,12-1;V,9;W,64)
• Understands the basic meaning of place value	BD (CA3;O,41;U3,06-2;V,8;W62)
• Understands the relative magnitude of whole numbers, fractions, decimals, and mixed numbers	BD (CA3;O,41;V,8;W64
• Uses models (e.g., number lines, two-dimensional and three-dimensional regions) to identify, order, and compare numbers .	BP (CA4;O,42;U3,06-1;V8;W,64)
Grades 6-8	
• Understands the relationships among equivalent number representations (e.g., whole numbers, positive and negative integers, fractions, ratios, decimals, percents, scientific notation, exponentials) and the advantages and disadvantages of each type of representation	BD (CA7;O,45;U6,05-1;V,13)
• Understands the characteristics and properties (e.g., order relations, relative magnitude, base-ten place values) of the set of rational numbers and its subsets (e.g., whole numbers, fractions, decimals, integers)	BD (CA6;O,45;U6,05-2;V,13;W,98)
• Understands basic number theory concepts (e.g., prime and composite numbers, factors, multiples, odd and even numbers, square numbers, roots, divisibility)	BD (CA6;O,46;U6,06-5;V,13;W,98)
• Understands the characteristics and uses of exponents and scientific notation	BD (CA7;O,46;V,14;W,104)
• Understands the concepts of ratio, proportion, and percent and the relationships among them	BD (O,45;U6,05-3;V,13;W,97)
Grades 9-12	
• Understands the properties (e.g., relative magnitude, density, absolute value) of the real number system and its subsystems (e.g., irrational numbers, natural numbers, integers, rational numbers)	BD (CA9-12;O,49;UEA,14-01;V,148;W,157)
• Understands the properties and basic theorems of roots, exponents (e.g., [bm][bn] = bm+n), and logarithms	BD (CA9-12;O,74;V,148;W,154)

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3. **Uses basic and advanced procedures while performing the processes of computation**	
Grades K-2	
• Adds and subtracts whole numbers	BP (C9-12;O,27;UK,08-1;V,5;W,55)
• Solves real-world problems involving addition and subtraction of whole numbers	BP (C9-12;O,40;UK,07-2;V,5;W,54)
• Understands the inverse relationship between addition and subtraction	BD (C9-12;U1,07-4;V,7;W,54)
• Adds, subtracts, multiplies, and divides whole numbers and decimals	BP (CA3;O,41;U3,08-1;V,8;W,62)
• Adds and subtracts simple fractions	BP (CA5;O,42;V,8;W,64)
• Uses specific strategies (e.g., front-end estimation, rounding) to estimate computations and to check the reasonableness of computational results	BP (CA3;O,92;U3,05-1;V,8;W,62)
• Understands the properties of and the relationships among addition, subtraction, multiplication, and division (e.g., reversing the order of two addends does not change the sum; division is the inverse of multiplication)	BD (CA3;O,41;U4,07-4;V,8;W,62)
• Understands factors and prime numbers	BD (CA4;O,42;U4,07-3;W,93)
Grades 6-8	
• Adds, subtracts, multiplies, and divides whole numbers, fractions, decimals, integers, and rational numbers	BP (CA7;O,46;U6,06-3;V,13;W,99)
• Understands the correct order of operations for performing arithmetic computations	BD (CA6;O,68;V,17;W,99)
• Uses proportional reasoning to solve mathematical and real-world problems (e.g., involving equivalent fractions, equal ratios, constant rate of change, proportions, percents)	BP (CA6;O,44;U6,07-3;V,15)
• Understands the properties of operations with rational numbers (e.g., distributive property, commutative and associative properties of addition and multiplication, inverse properties, identity properties)	BD (CA6;O,45;U6,06-4;V,15;W,98)
• Knows when an estimate is more appropriate than an exact answer for a variety of problem situations	BD (CA7;O,95;U6,07-2;W,96)

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Grades 9-12	
• Adds, subtracts, multiplies, divides, and simplifies rational expressions	BP (CA9-12;O,74;V,18;W,154)
4. Understands and applies basic and advanced properties of the concepts of measurement	
Grades K-2	
• Understands the concept of time and how it is measured	BD (CAK;O,79;UK,10-4;V,7;W,55)
• Knows processes for telling time, counting coins, and measuring length, weight, and temperature, using basic standard and nonstandard units	BD (CAK;O,79;U1,10-4;V,4;W,55)
• Makes quantitative estimates of familiar linear dimensions, weights, and time intervals and checks them against measurements	BP (CA2;O,91;U1,10-4;V,4;W,49)
Grades 3-5	
• Understands the basic measures perimeter, area, volume, capacity, mass, and circumference	BD (CA3;O,81;U4,10-1;V10;W63)
• Selects and uses appropriate tools for given measurement situations (e.g., rulers for length, measuring cups for capacity)	BP (O,80;U3,10-4;V,10;W,63)
• Knows approximate size of basic standard units (e.g., centimeters, feet, grams) and relationships between them (e.g., between inches and feet)	BD (CA3;O,83;U3,10-4;V,10;W,95)
• Uses specific strategies to estimate quantities and measurements (e.g., estimating the whole by estimating the parts)	BP (CA3;O,81;U3,05-4;V,8;W,62)
• Selects and uses appropriate units of measurement, according to type and size of unit	BP (CA3;O,80;U3,10-2;W,67)
• Measures elapsed time to the nearest minute	BP (O,80;U4,10-4;V,8)*

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Grades 6-8	
• Solves problems involving perimeter (circumference) and area of various shapes (e.g., parallelograms, triangles, circles)	BP (CA6;O,46;U6,13-5;V,14;W,98)
• Solves problems involving units of measurement and converts answers to a larger or smaller unit within the same system (i.e., standard or metric)	BP (CA7;O,83;U6,13-4;V,14)
• Selects and uses appropriate estimation techniques (e.g., overestimating, underestimating, using a range of estimates) to solve real-world	BP (O,84;U6,13-2;V,13;W,101)
• Uses measurement formulas (e.g., to calculate area, volume, surface area)	BD (CA6;O,84;U6,13-7;V,15;W101)
• Selects and uses standard and nonstandard units and tools, depending on degree of accuracy required, to find measurements for real-world problems	BP (O,83;U6,13-3;V,14;W,101)
Grades 9-12	
• Solves real-world problems involving three-dimensional measures (e.g., volume, surface area)	BP (CA9-12;O,88;V,20;W,151)
5. Understands and applies basic and advanced properties of the concepts of geometry	
Grades K-2	
• Understands the common language of spatial sense (e.g., "inside," "between," "above," "below," "behind")	BD (CAK;O,54;UK;09-3;V,6;W,50)

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Grades 3-5	
• Knows basic geometric language for describing and naming shapes (e.g., trapezoid, parallelogram, cube, sphere)	BD (CA3;O,54;U3,09-1;V,12;W,63)
• Understands basic properties of figures (e.g., two- or three-dimensionality, symmetry, number of faces, type of angle)	BD (CA3;O,55;U3,09-1;V,9;W,67)
• Understands that shapes can be congruent or similar	BD (CA4;O,57;U3,09-1;V,9;W,63)
• Understands characteristics of lines (e.g., parallel, perpendicular, intersecting) and angles (e.g., right, acute)	BD (CA3;O.54;U3,09-1;V,10;W,94)
Grades 6-8	
• Understands the defining properties of three-dimensional figures (e.g., a cube has edges with equal lengths, faces with equal areas and congruent shapes, right-angle corners)	BD (CA7;O,57;U6,12-1;V,14;W,100)
• Understands geometric transformations of figures (e.g., rotations, translations, dilations)	BD (O,57;U6,12-3;V,17;W,100)
• Understands the mathematical concepts of similarity (e.g., scale, proportion, growth rates) and congruency	BD (CA7;O,57;V,14;W,100)
Grades 9-12	
• Understands that objects and relations in geometry correspond directly to objects and relations in algebra (e.g., a line in geometry corresponds to a set of ordered pairs satisfying an equation of the form ax + by = c)	BD (O,23;UG,04-2;V,19;W,154)
• Uses the Pythagorean Theorem and its converse and properties of special right triangles (e.g., 30°-60°-90° triangle) to solve mathematical and real-world problems	BP (CA9-12;O,61;UEA,09-1;V,20;W,151)
• Uses synthetic (i.e., pictorial) representations and analytic (i.e., coordinate) methods to solve problems involving symmetry and transformations of figures (e.g., problems involving distance, midpoint, and slope; determination of symmetry with respect to a point or line)	BP (CA9-12;O,62;UEA,07-1;V,20;W,15)
• Uses geometric constructions (e.g., the parallel to a line through a given point not on the line, line segment congruent to a given line segment) to complete simple proofs, to model, and to solve mathematical and real-world problems	BP (CA9-12;O,61;UG,03-4;V,20;W,152)

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• Understands the basic concepts of right triangle trigonometry (e.g., basic trigonometric ratios such as sine, cosine, and tangent)	BD (CA9-12;O,23;UG,09-1;V,20;W,152)
• Uses inductive and deductive reasoning to make observations about and to verify properties of and relationships among figures (e.g., the relationships among interior angles of parallel lines cut by a transversal)	BP (CA9-12;O,61;V,20;W,151)
• Uses properties of and relationships among figures to solve mathematical and real-world problems (e.g., uses the property that the sum of the angles in a quadrilateral is equal to 360 degrees to square up the frame for a building; uses understanding of arc, chord, tangents, and properties of circles to determine the radius given a circular edge of a circle without the center)	BP (CA9-12;O,61;UEA,08-2;V,20;W,151)
6. Understands and applies basic and advanced concepts of statistics and data analysis	
Grades K-2	
• Understands that observations about objects or events can be organized and displayed in simple graphs	BD (CAK;O,103;UK,11-1;V,4;W,50)
Grades 3-5	
• Organizes and displays data in simple bar graphs, pie charts, and line graphs	BP (CA3;O,104;U3, 11-1;V,9:W,64)
• Reads and interprets simple bar graphs, pie charts, and line graphs	BP (O,103;U3,11-2;V,9;W,67)
Grades 6-8	
• Understands basic characteristics of measures of central tendency (i.e., mean, mode, median)	BD (CA6;O,106;V,14;W,106)
• Uses data and statistical measures for a variety of purposes (e.g., formulating hypotheses, making predictions, testing conjectures)	BP (CA7;O,107;U6,10-3;V,16)
• Organizes and displays data using tables, graphs (e.g., line, circle, bar), frequency distributions, and plots (e.g., stem-and-leaf, box-and-whiskers, scatter)	BP (CA7;O,107;U6,10-1;V,14;W,96)

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Grades 9-12	
• Selects and uses the best method of representing and describing a set of data (e.g., scatter plot, line graph, two-way table)	BP (CA9-1;O,110;UEA,10-1;V,22)
• Understands measures of central tendency and variability (e.g., standard deviation, range, quartile deviation) and their applications to specific situations	BD (CA9-12;O,73;UEA,10-3;V,19)
• Understands different methods of curve-fitting (e.g., median-fit line, regression line) and various applications (e.g., making predictions)	BD (CA9-12;O,110;UEA,10-2;V,19)
7. Understands and applies basic and advanced concepts of probability	
Grades K-2	
• [insufficient evidence to support benchmarks at this level]	
Grades 3-5	
• Uses basic sample spaces (i.e., the set of all possible outcomes) to describe and predict events	BP (O,104;U4,11-1;V,12;W,94)
Grades 6-8	
• Determines probability using mathematical/theoretical models (e.g., table or tree diagram, area model, list, counting procedures, sample space)	BP (CA6;O,106;U6,11-2;V,14;W,112)
• Determines probability using simulations or experiments	BP (O,106;U6,11-1;V,4;W,100)
• Understands how predictions are based on data and probabilities (e.g., the difference between predictions based on theoretical probability and experimental probability)	BD (O,106;U6,11-3;V,16;W,100)

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Grades 9-12	
• [insufficient evidence to support benchmarks at this level]	
8. Understands and applies basic and advanced properties of functions and algebra	
Grades K-2	
• Recognizes regularities in a variety of contexts (e.g., events, designs, shapes, sets of numbers)	BP (CAK;O,17;UK,03-4;V,5;W,50)
• Extends simple patterns (e.g., of numbers, physical objects, geometric shapes)	BP (CAK;O,17;UK,13-1;V,6;W,56)
Grades 3-5	
• Recognizes a wide variety of patterns (e.g., basic linear patterns such as [2, 4, 6, 8 . . .] ; simple repeating and growing patterns) and the rules that explain them	BP (CA3;O,28;U3,13-1;V,9;W,68)
• Knows that a variable is a letter or symbol that stands for one or more numbers	BD (CA4;O,66;U5,09-1;V,12;W,94)
• Solves simple open sentences involving operations on whole numbers (e.g., _+ 17 = 23)	BP (CA4;O,65;U5,09-5;V,12;W,94)
Grades 6-8	
• Knows that an expression is a mathematical statement using numbers and symbols to represent relationships and real-world situations (e.g., equations and inequalities with or without variables)	(CA6;O,69;U6,09-1;W,99)
• Understands various representations (e.g., tables, graphs, verbal descriptions, algebraic expressions, Venn diagrams) of patterns and functions and the relationships among them	BD (CA7;O,21;U6,09-1;V,16;W,99)
• Understands the basic concept of a function (i.e., a function describes how changes in one quantity or variable result in changes in another)	BD (O,68;U6,08-3;V,16;W,99)
• Solves linear equations using concrete, informal, and formal methods (e.g., using properties, graphing ordered pairs, using slope-intercept form)	BP (CA6;O,69;U609-3;V,14;W,99)
• Uses the rectangular coordinate system to model and to solve problems	BP (CA7;O,69;U6,05-5;V,16;W,98)

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Grades 9-12	
• Understands appropriate terminology and notation used to define functions and their properties (e.g., domain, range, function composition, inverses)	BD (CA9-12;O,23;V,19;W,154)
• Understands basic concepts (e.g., roots) and applications (e.g., determining cost, revenue, and profit situations) of polynomial equations	BD (CA9-12;O,23;V,19;W,154)
• Uses a variety of models (e.g., written statement, algebraic formula, table of input-output values, graph) to represent functions, patterns, and relationships	BP (CA9-12;O,23;UEA,06-2;V,18;W,154)
• Understands the general properties and characteristics of many types of functions (e.g., direct and inverse variation, general polynomial, radical, step, exponential, logarithmic, sinusoidal)	BD (O,23;UIA7,06-7;V,19;W,155)
• Uses a variety of methods (e.g., with graphs, algebraic methods, and matrices) to solve systems of equations and inequalities	BP (CA9-12;O,72;UEA,05-3;V,18;W,147)
• Understands formal notation (e.g., sigma notation, factorial representation) and various applications (e.g., compound interest) of sequences and series	BD (CA9-12;O,73;UIA,13-2;V,22)

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SCIENCE

Identification of National Reports

For the subject area of science, two evaluation reports were used to help select the state documents analyzed in this study. One report we used was the American Federation of Teachers' (AFT) *Making Standards Matter* (1998), which includes ratings of the state standards in terms of specificity and clarity. Another perspective on state standards was available from the Fordham Foundation in the report *State Science Standards: An Appraisal of Science Standards in 36 States* (Lerner, 1998).

Selection of Reference Documents

As we noted in the Introduction to this report, five state documents were selected for review for each subject area covered in this report. The selection of the top five state documents for science was determined by a simple comparison of the two evaluation reports just described. Specifically, those states that received a "B" or above in the Fordham report were compared with those states identified in the AFT's *Making Standards Matter* report as having clear and specific standards. Six states were found to be highly rated in both reports. As five states had been established as the limit for this study, the lowest scoring state was dropped. The following state documents were used for the analysis of science content:

Rhode Island Science Framework (1996, August 14), by the Rhode Island Department of Education

Science Content Standards Grades K–12 (Prepublication Ed.) (1998, February 2), by the California State Board of Education

Science Curriculum Framework (1998, March), by the Connecticut State Department of Education, Division of Teaching and Learning

Science Language Arts Curriculum Framework (1995, June), by the Delaware Department of Education)

Science Standards (1998, August 24), by the Arizona Department of Education

Findings

The standards and benchmarks that resulted from our synthesis of state standards follows this introduction. For the area of science, several observations should be noted.

First, it became clear that at least a few topics addressed in the national science documents (such as the National Research Council's *National Science Education Standards,* 1996, and *Project 2061's Benchmarks for Science Literacy,* 1993) received little or no attention in the state documents

under review. Such topics appear, for example, under the *Compendium* standard "Understands the nature of scientific knowledge." This standard has as its focus basic concepts regarding the importance of replication in scientific experiments, the criteria for valid scientific explanations, and how scientific knowledge changes and accumulates over time. Little in the state documents under review addressed this particular area.

Second, as mentioned in the Introduction to this report (see Product and Caveat section), it became clear that the process of content reduction resulted in the loss of any scope and sequence present in the documents. In part, this side effect was caused by the considerable amount of "declarative knowledge" that is typically addressed in science curricula.

Declarative knowledge, a category of knowledge that encompasses facts, events, episodes, principles, generalizations, and the like, is contrasted with procedural knowledge, which is "how to" knowledge. *Procedural knowledge* includes knowing how to apply algorithms or other processes that are composed of steps, whether the steps must be taken in specific order (such as the steps involved in hitting a golf ball) or can be taken in a number of ways (such as the process for reading a map). We have observed that declarative knowledge especially, in the form of observations or statements about the world, is frequently organized in science curricula in a manner designed to help students connect earlier, simpler ideas as they come to understand larger generalizations or principles. Because the power of overarching ideas is that they can organize a number of ideas and connect many facts, it should not be surprising that different states might choose different facts as building blocks for these ideas. For example, some state curricula might determine that a precursor notion to fully understanding the rock cycle might be the understanding that rocks vary by size and shape; another state might focus on the fact that rocks contain evidence of the past, such as fossil remains, which in part gives a clue to the formation of rocks over time. In either case, these concepts can be unified under a more general understanding of the cycle through which rocks are formed and reformed. As content was compared across documents in this study, however, such "building blocks" did not appear across enough states to warrant their inclusion in this synthesis. However, it should be noted that such larger concepts as the rock cycle, found in at least four of the five state documents under review, will be found here. This result, the identification and presentation of the most significant information found across highly rated state standards, was the purpose of this study.

Summary of State Benchmarks for Science

Table 3 provides a listing of the benchmarks developed by national groups which are included in the state standards document for at least four of the five top rated states in Science. The state benchmarks are organized around the following fifteen Science standards:

Earth and Space

1. Understands basic features of the Earth
2. Understands basic Earth processes
3. Understands essential ideas about the composition and structure of the universe and the Earth's place in it

Life Sciences

4. Knows about the diversity and unity that characterize life
5. Understands the genetic basis for the transfer of biological characteristics from one generation to the next
6. Knows the general structure and functions of cells in organisms
7. Understands how species depend on one another and on the environment for survival
8. Understands the cycling of matter and flow of energy through the living environment
9. Understands the basic concepts of the evolution of species

Physical Sciences

10. Understands basic concepts about the structure and properties of matter
11. Understands energy types, sources, and conversions, and their relationship to heat and temperature
12. Understands motion and the principles that explain it
13. Knows the kinds of forces that exist between objects and within atoms

Nature of Science

14. Understands the nature of scientific inquiry
15. Understands the scientific enterprise

Table 3. Summary of State Science Benchmarks

Earth and Space	
1. Understands basic features of the Earth	
Grades K-2	
• Understands that water can be made to go back and forth between liquid forms and solid forms and gradually disappears if left uncovered (e.g., mud puddles, clothes drying on a clothes line)	BD (CAK,CT129I,D5I*i*,R5I)
• Understands that short-term weather conditions can change daily but that each season is characterized by general weather patterns; these changes in weather influence plant, animal, and human activities	BD (A6I,CAK,CT131I,D5I,R5I)
• Uses simple weather instruments (e.g., thermometer, wind vane, rain gauge) to measure and record changes in weather from day to day and over seasons	BP (A6I,CA1,CT131I,D5I)*
Grades 3-5	
• Knows that water exists in the air in different forms (e.g., clouds, fog, rain, snow, hail)	BD (A6II*i*,CA5,CT129I, D5II)
• Knows that the night and day cycle is caused by the Earth's rotation on its axis	BD (A6II,CT134II,D4I,R5II)
Grades 6-8	
• Knows the composition and structure of the Earth's atmosphere (e.g., temperature and pressure in different layers of the atmosphere, circulation of air masses, fronts) and its role in weather patterns	BD (A6III,CA9-12,CT131II,D5III)
• Knows how the tilt of the Earth's axis and the Earth's revolution around the Sun affect seasons and day length (i.e., the amount of solar energy that hits the Earth's surface varies with time of year and location)	BD (A6III,CT132IV,D4II,R5III)
• Knows various factors that affect weather patterns (e.g., pressure, heat, humidity, oceans and other large bodies of water, mountain ranges, cities)	BD (A6III,CA6,CT132III,D5III)*

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CT115-1421-IV = CT: page #; I-IV: Prim., Elem., Middle, H.S.
D1-8U-IV = DE; Std #, I-IV; Prim., Elem., Middle, H.S.
R1-21I-IV = RI; Std #, I-IV: Prim., Elem., Middle, H.S.

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• Understands the processes involved in the water cycle (e.g., evaporation, condensation, precipitation, surface run-off, percolation) and their effects on weather and climate	BD (A61V,CA5,CT129III,D5III)
Grades 9-12	
• Understands heat and energy transfer in and out of the atmosphere and its involvement in weather and climate (e.g., radiation, conduction, convection/advection)	BD (A6IV,CA9-12,CT131IV,D4IV,R5IV)
• Understands the factors that influence water quality, supply, use, reuse, recycling, conservation, and management	BD (A6IV,CA9-12*i*,CT129IV,D5IV)*
2. Understands basic Earth processes	
Grades K-2	
• [insufficient evidence to support benchmarks at this level]	
Grades 3-5	
• Knows the composition and properties of soils (e.g., components of soil such as weathered rock, living organisms, plant and animal remains; properties of soil such as color, texture, capacity to retain water, ability to support plant growth)	BD (CA2,CT128II,D5II,R6III)
• Knows how features on the Earth's surface are constantly changed by a combination of slow and rapid processes (e.g., weathering, erosion, transport, deposition of sediment by waves, wind, water, and ice; landslides, volcanic eruptions, earthquakes, floods, ice and snow storms, hurricanes, tornadoes, droughts)	BD (A6I,CA4,CT128II,D5I)
Grades 6-8	
• Understands the processes involved in the rock cycle (e.g., formation, weathering, sedimentation, metamorphism)	BD (CA7,CT127III,D5III,RIII)

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Grades 9-12	
• Understands the concept of plate tectonics and the evidence that supports it (including structural, geophysical, and paleontological evidence	BD (A6IV,CA9-12,CT127IV,D5IV,R6IV)
3. Understands essential ideas about the composition and structure of the universe and the Earth's place in it	
Grades K-2	
• Knows the basic patterns of objects in the sky (e.g., the Sun appears every day; the Moon appears sometimes at night and sometimes during the day; the Sun and Moon appear to move from east to west across the sky; the Sun's position in the sky changes through the seasons; the Moon appears to change shape over the course of a month; stars move slowly across the sky)	BD (A6K,CA3,CT133I,D4I,R4I)
Grades 3-5	
• Knows that the Earth is one of several planets that orbit the Sun and that the Moon orbits around the Earth	BD (CA3,CT134II,D4II,R4II)
• Knows that the patterns of stars in the sky stay the same, although they appear to slowly move from east to west across the sky nightly and different stars can be seen in different seasons	BD (A6I,CA3,CT134II,D4II,R4II)
• Understands the impact of technology (e.g., telescopes, space exploration) on our knowledge of Earth and space science	BD (A6II,CA3,CT134II,D4II)*
Grades 6-8	
• Knows the characteristics of the Sun and its position in the universe (e.g., the Sun is a medium-sized star composed of hydrogen and helium; it is the closest star to Earth; it is the central and largest body in the Solar System; it is located at the edge of the Milky Way, a disk-shaped galaxy of stars	BD (CA5,CT133III,D4III,R4III)
• Knows the characteristics and movement patterns of objects in the Solar System (e.g., sun, planets, moons, asteroids, comets, meteors)	BD (A6II,CA8,CT133III,R4III)
• Knows the basic characteristics of stars, galaxies, and the universe (e.g., galaxies are clusters of billions of stars, the universe contains many billions of galaxies)	BD (A6III,CA8,CT133III,D4III,R4III)

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• Knows that most objects in space are massive in size and are separated from one another by vast distances (e.g., many stars are more massive than the Sun but so distant they look like points of light) and that such distances are measured using astronomical units and light years	BD (CA8,CT134IV,D4III,R4III)
Grades 9-12	
• Knows that although the origin of the universe remains one of the greatest questions in science, current scientific evidence supports the "big bang" theory (e.g., between 10 and 20 billion years ago, the entire contents of the universe expanded explosively into existence from a single, hot, dense, chaotic mass; our solar system formed from a cloud of dust and gas about 4.6 billion years ago)	BD (A6IV,CA9-12,D4IV,R4IV)
• Knows the ongoing processes involved in star formation and destruction (e.g., stars condense out of clouds of molecules of the lightest elements; nuclear fusion of light elements into heavier ones occurs in the stars' extremely hot, dense cores, releasing great amounts of energy; some stars eventually explode, producing clouds of material from which new stars and planets condense)	BD (CA9-12,CT134IV,D4IV,R4IV)
• Knows ways in which technology has increased our understanding of the universe (e.g., visual, radio, and x-ray telescopes collect information about the universe from electromagnetic waves; space probes gather information from distant parts of the Solar System; math models and computer simulations are used to study evidence from many sources in order to form a scientific account of events in the universe)	BD (A6III,CT134IV,D4III,R4IV)
Life Sciences	
4. Knows about the diversity and unity that characterize life	
Grades K-2	
• Knows that plants and animals have features that help them live in different environments	BD (CAI,CT123I,D7I,R11I)
• Knows that there are similarities and differences in the appearance and behavior of plants and animals	BD (A1K,CAK,CT123I,R11I)*
• Knows that plants and animals progress through life cycles of birth, growth and development, reproduction, and death; the details of these life cycles are different for different organisms (e.g., frog, butterfly, cat, dandelion)	BD A4I,CA2,CT126II,D7I)

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Grades 3-5	
• Knows different features that can be used to group living things (e.g., feathers, leaves, types of homes)	BD (A4II,CT123II,D7I,R1III)
Grades 6-8	
• Knows ways in which living things can be classified (e.g., taxonomic groups of plants, animals, and fungi; groups based on the details of organisms' internal and external features; groups based on functions served within an ecosystem)	BD (A4III,CA6,CT123III,D7III,R1III)
Grades 9-12	
• Knows how DNA and protein sequences are used to infer evolutionary relationships among organisms and to classify organisms	BD (A4IV,CT123IV,D7IV,R1IIV)
• Knows how variations in organisms within a species and diversity among species increase the likelihood that at least some organisms will survive major changes in the environment	BD (A4IV,CA9-12,CT123IV,D7IV,R1IIV)
5. Understands the genetic basis for the transfer of biological characteristics from one generation to the next	
Grades K-2	
• Knows that plants and animals closely resemble their parents	BD (A4I,CA2,CT125I,D7I,R12I)
• Knows that differences exist among individuals of the same kind of plant or animal	BD (CA2,CT125I,D7II,R12I)
Grades 3-5	
• Knows that organisms inherit many of their characteristics from their parent(s)	BD (A4II,CA2,CT126II,D7II)
Grades 6-8	
• Understands the similarities and differences between sexual and asexual reproduction	BD (A4IV*i*,CA7,CT126III,D7III,R12III)
• Knows that hereditary information is contained in genes, which are located in the chromosomes of each cell	BD (A4III,CA7,CT125III,D7III)

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Grades 9-12	
• Knows the chemical and structural properties of DNA and the role of DNA in heredity and protein synthesis (e.g., DNA synthesis, translation, transcription; mRNA and codons; effect of mutations)	BD (A4IV,CA9-12,D6IV,R12IV)
• Knows how DNA mutations in an organism's sex cells may increase genetic variation within a species (e.g., insertions, deletions, substitutions, transversions, recombination, incorporation of exogenous DNA)	BD (A4IV,CA9-12,CT126IV,R12IV)
• Understands Mendel's laws of heredity (e.g., segregation and independent assortment)	BD (CA9-12,CT125IV,D7IV,R12IV)*
6. Knows the general structure and functions of cells in organisms	
Grades K-2	
• Knows the basic needs of plants and animals (e.g., air, water, nutrients, light or food)	BD (A4K,CA1,CT129I,R17I)
Grades 3-5	
• Knows that living organisms have distinct structures and body systems that serve specific functions in growth, survival, and reproduction (e.g., body structures for walking, flying, swimming; digestive, circulatory, and skeletal systems in vertebrates, invertebrates, unicellular organisms, and plants)	BD (A4I,CA3,CT124II,D6II,R17III)
Grades 6-8	
• Knows that all organisms are composed of cells, which are the fundamental units of life; organisms may be unicellular or multicellular	BD (CA7,CT121II,D6III,R13III)
• Knows the basic components and functions of cells and the differences among various types of cells (e.g., plant, animal, and prokaryotic; muscle, nerve, bone)	BD (A4II,CA7,CT121II,D6III,R13III)
• Knows that multicellular organisms have a variety of specialized cells, tissues, organs, and organ systems that perform specialized functions (e.g., respiration, circulation, digestion, excretion, reproduction, movement, coordination, protection from disease)	BD (A4III,CA5,CT121III,D6III,R13III)

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Grades 9-12	
• Understands the processes of cell division (e.g., mitosis and meiosis) and cell differentiation	BD (AIV,CA9-12,CT121IV,D7III,R12IV)
• Knows the structures of proteins (e.g., long, usually folded chain molecules made of specific sequences of amino acids coded by the DNA)	BD (CA9-12,CT121IV,D6IV,R13IV)
7. Understands how species depend on one another and on the environment for survival	
Grades K	
• [insufficient evidence to support benchmarks at this level]	
Grades 3-5	
• Knows that organisms can react to internal and environmental stimuli through behavioral response (e.g., plants have tissues and organs that react to light, water, and other stimuli; animals have nervous systems that process and store information from the environment)	BD (A4IV,CA2,CT124II,D6II)
Grades 6-8	
• Knows factors that affect the number and types of organisms an ecosystem can support (e.g., available resources; abiotic factors such as quantity of light and water, range of temperatures, and soil composition; disease; competition from other organisms within the ecosystem; predation)	BD (A3IV,CA6,CT120III,D8III)
Grades 9-12	
• Knows ways in which humans can alter the equilibrium in ecosystems, causing irreversible effects (e.g., human population growth, technology, and consumption; human destruction of habitats through direct harvesting, pollution, and atmospheric changes)	BD (CA9-12,CT120IV*i*,D8III,R3IV)
8. Understands the cycling of matter and flow of energy through the living environment	
Grades K-2	

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• [insufficient evidence to support benchmarks at this level]	
Grades 3-5	
• [insufficient evidence to support benchmarks at this level]	
Grades 6-8	
• Knows how matter is recycled within ecosystems (e.g., matter is transferred from one organism to another repeatedly, and between organisms and their physical environment; the total amount of matter remains constant, even though its form and location change)	BD (A4IV,CA6,CT120III,D8III,R15III)
Grades 9-12	
• Knows that as matter and energy flow through different levels of organization in living systems and between living systems and the physical environment, chemical elements (e.g., carbon, nitrogen) are recombined in different ways	BD (A4IV*i*,CA9-12,D8IV,CT122IV*i*,R15IV)
• Knows how the amount of life an environment can support is limited by the availability of matter and energy and the ability of the ecosystem to recycle materials	BD (A3IV,CT120IV,D8IV,R15IV)
9. Understands the basic concepts of the evolution of species	
Grades K-2	
• [insufficient evidence to support benchmarks at this level]	
Grades 3-5	
• Knows that fossils can be compared to one another and to living organisms to observe their similarities and differences	BD (A4II,CA3,D7I,CT125II)
Grades 6-8	
• [insufficient evidence to support benchmarks at this level]	

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Grades 9-12	
• Understands the concept of natural selection (e.g., when an environment changes, some inherited characteristics become more or less advantageous or neutral, and chance alone can result in characteristics having no survival or reproductive value)	BD (A4IV,CA9-12,D7III,R16IV)
• Understands the theory of biological evolution (e.g., the Earth's present-day life forms evolved from earlier, distinctly different species)	BD (A4IV,CA7,CT125III,D7IV,R16IV)
Physical Sciences	
10. Understands basic concepts about the structure and properties of matter	
Grades K-2	
• Knows that different objects have many different observable characteristics (e.g., material composition, color, size, shape, weight, texture) and can be sorted and classified by these characteristics	BD (A1K,CAK,CT135I,D2I)
Grades 3-5	
• Knows that substances can be classified by their physical and chemical properties (e.g., conductivity, magnetism, density, solubility, boiling and melting points)	BD (A5II,CA8,CT135III*i*,D2II)
• Knows that matter has different states (solid, liquid, gas) and that each state has distinct physical properties; some common materials such as water can be changed from one state to another by heating or cooling	BD (A5I,CA3,CT135II,D2I)
Grades 6-8	
• Knows that the states of matter depend on molecular arrangement and motion (e.g., in the solid state, molecules are packed tightly together with their movement restricted to vibrations; in the liquid state, molecules have higher energy and are more loosely packed, moving freely and randomly past each other; in the gaseous state, molecules are less restricted and move freely)	BD (CA8,CT135III,D2III,R7III)

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• Understands the conservation of matter in physical and chemical change (e.g., regardless of how substances within a closed system interact with one another, the total weight of the system remains the same; the same number of atoms weighs the same, no matter how the atoms are arranged)	BD (A5IV,CA8,CT135III,D2III,R7III)
• Understands the nature of the physical and chemical properties of atoms, matter, molecules, elements, compounds, mixtures, and solutions	BD (A5III,CA5,CT135III,D2III,R7II)
Grades 9-12	
• Understands that the placement of elements on the Periodic Table of Elements is determined by common chemical properties (e.g., atomic number), which results in the grouping of elements with similar chemical and physical properties (e.g., metals, inert gases); this arrangement makes the table useful for predicting common properties of elements and compounds	BD (A5IV,CA8,CT135IV,D2IV,R7IV)
• Knows how the electron configuration of atoms governs the chemical properties of an element as atoms interact with one another by transferring or sharing the outermost electrons forming ionic, covalent, or metallic bonds	BD (A5IV,CA9-12,CT135IV,D2IV,R7IV)
• Knows that atoms may be bonded together into distinct molecules which may form solids by building up repeating patterns (e.g., crystal structures, long chain polymers)	BD (CA9-12,CT135IV,D2IV,R7IV)
• Knows that reaction rates depend on a variety of factors that influence the frequency of collision of reactant molecules (e.g., concentration, temperature, pressure, the presence or absence of a catalyst)	BD (CA9-12,CT135IV,D2IV,R7IV)
• Uses chemical formulas and balanced equations to quantify relationships between reactants and products in chemical reactions (e.g., synthesis, decomposition, replacement, combustion) and to predict the products of a reaction	BD (A5IV,CA9-12,CT135IV,D2IV)*
11. Understands energy types, sources, and conversions, and their relationship to heat and temperature	
Grades K-2	
• Knows that the Sun supplies heat and light to the Earth	BD (A6K,CA1,CT137I,D3I)

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Grades 3-5	
• Knows the organization of a simple electrical circuit	BD (CA4,CT139III*i*,D3II,R8IV)
Grades 6-8	
• Understands the law of conservation of energy (i.e., energy cannot be created or destroyed but only changed from one form to another)	BD (A5III,CA9-12,CT137III,D3III,R8IV)
• Understands that heat can be transferred from warmer objects or areas to cooler ones through conduction, convection, and radiation until both objects reach the same temperature (e.g., the distribution of heat in the atmosphere and oceans by convection currents)	BD (A5III,CA6,CT137III,D3III,R8III)
• Knows that most physical and chemical reactions involve a transfer of energy (e.g., heat, light, mechanical motion, electricity)	BD (A5III*i*,CA8,CT137III,D3III,R8III)
• Knows that heat is often a byproduct of energy transformations (e.g., heat is produced by machines and living things when they convert stored energy to motion)	BD (CA6,CT137III,D3III,R8III)
Grades 9-12	
• Understands the concept of entropy and the second law of thermodynamics (e.g., although the total energy of the universe remains constant, matter tends to become steadily less ordered as various energy transfers occur and the energy tends to spread out uniformly, thereby decreasing the amount of useful energy)	BD (A5IV,CA9-12,CT137IV,R8IV)
• Understands the distinction between kinetic and potential energy	BD (CA9-12,CT137IV,D3III, R8IV)
12. Understands motion and the principles that explain it	
Grades K-2	
• Knows that vibrating objects produce sound, which can be characterized by its pitch and volume	BD (CA2,CT137I,D3I,R9I)
• Knows that the position and motion of an object can be changed by pushing or pulling (i.e., by forces)	BD (CA2,CT139I,D3I,R9I)

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Grades 3-5	
• Knows that light can be reflected, refracted, transmitted, or absorbed by different materials (e.g., mirrors, lenses, shadows)	BD (A5I,CA3,CT138III,D3II)
Grades 6-8	
• Knows the characteristic properties of mechanical and electromagnetic waves (e.g., wavelength, frequency, amplitude, speed; absorption, reflection, refraction), that they have energy, and that they can transfer energy when they interact with matter	BD (CA9-12,CT139III,D3III,R9III)
• Understands Newton's laws of motion (e.g., the effects of two or more forces on an object at once is the cumulative effect of all the forces; with balanced forces or in the absence of a force, there is no change in motion, whereas unbalanced forces such as friction will cause changes in the speed and/or direction of an object's motion)	BD (A5III,CA8,CT139III*i*,D3III,R9III)
Grades 9-12	
• [insufficient evidence to support benchmarks at this level]	
13. Knows the kinds of forces that exist between objects and within atoms	
Grades K-2	
• Knows that some forces (e.g., magnetism, gravity, static electricity) can make some things move without touching them	BD (CA2,CT139I,D3I,R10I)
Grades 3-5	
• [insufficient evidence to support benchmarks at this level]	
Grades 6-8	
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Grades 9-12	
• Knows that magnetic forces are very closely related to electric forces and can be thought of as different aspects of a single electromagnetic force (moving electric charges produce magnetic forces and moving magnets produce electric forces)	BD (CA9-12,CT139III,D3IV,R10III)
• Understands general concepts related to gravitational force (e.g., every object exerts gravitational force on every other object; this force depends on the mass of the objects and their distance from one another)	BD (A5IV,CA9-12,CT137IV,R10III)
Nature of Science	
14. Understands the nature of scientific inquiry	
Grades K-2	
• Formulates questions about the natural world, seeks answers by making careful observations, and communicates observations orally and in drawings	BP (A1K,CAK,CT115I,DII,R20I)
• Knows how to use simple tools (e.g., thermometers, magnifiers, rulers, balances, watches) to gather information and extend the senses	BD (A3K,CA2,CT115I,DII,RII)
Grades 3-5	
• Plans and conducts simple investigations (i.e., develops a testable question, makes systematic observations, conducts simple experiments to answer questions, develops a logical conclusion, and communicates findings to others)	BP (AI,CA3,CT116II,DIII)
• Uses appropriate tools and simple equipment to gather scientific data and extend the senses (e.g., rulers, thermometers, magnifiers, microscopes, calculators)	BP (CA5,CT117II,DII,RIII)

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Grades 6-8	
• Designs and conducts scientific investigations (i.e., formulates hypotheses, designs and executes investigations, interprets data, synthesizes evidence into explanations, proposes alternative explanations for observations, critiques explanations and procedures, and communicates steps and results from an investigation in written reports and verbal presentations)	BP (A1III,CA6,CT115III,D1III)
Grades 9-12	
• Designs and conducts scientific investigations (i.e., formulates testable hypotheses; identifies and clarifies the method, controls, and variables; organizes, displays, and analyzes data; revises methods, explanations, and hypotheses; presents the results; and receives critical response from others)	BP (A1IV,CA9-12,CT115IV,D1IV)
15. Understands the scientific enterprise	
Grades K-2	
• Knows that people invent new technological devices to solve problems in everyday life (e.g., zippers, paper clips, telephones, microwave ovens)	BD (A3I,CT141II,D1I,R3I)*
Grades 3-5	
• Understands the interrelationship between science and technology (e.g., science creates opportunities for technological developments; new technologies allow scientific investigations that were previously impossible to be conducted)	BD (A2II,CT19II,D1IV,RII)*
• Understands that although technology solves many problems, it can also create new problems (e.g., it may not be equally available to everyone, it may significantly impact the environment, resource limitations may be an issue, there may be unforeseen ethical implications)	BD (A3II,CT141II,D1II,R2II)*

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Grades 6-8	
• Knows ways in which science and society influence each other (e.g., scientific knowledge and the procedures used by scientists influence the way many individuals think about themselves, others, and the environment; technology can contribute to the solution of an individual or community problem; social and economic forces strongly influence which science and technology programs are pursued, invested in, and used)	BD (A2II,CT118III,D1III,R3III)
Grades 9-12	
• Knows that throughout history, diverse cultures have developed scientific ideas and solved human problems through technology	BD (A2IV,CT118IV,DIV,R3IV)

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